REMARKS

In this response, claims 1-31 have been cancelled, without prejudice, and claims 32-58 have been amended. Support for these amendments is found throughout the originally submitted application. No new matter has been added.

Claims 32 – 58 are presently pending.

Cited References

Claims 1 – 31 were rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 5,402,004 issued to Ozmat et al ("Ozmat") in view of US Publication 2003/022732 A1 filed by Dessiatoun et al ("Dessiatoun") and further in view of US Publication 2002/0108743 A1 filed by Wirtz ("Wirtz") or, alternatively, in view of US Publication 2004/0022027 A1 filed by Weber et al. ("Weber"). While the cancellation of these claims renders these rejections moot, the Applicant will discuss these various references with respect to new claims 32 – 58.

New Claims

Claim 32 recites an apparatus comprising:

> a die including at least one integrated circuit and a surface;
> a heat exchanger; and
> a thermal management device having
> a case with a plate attached to the surface of the die and a cavity, and
> a porous medium disposed within the cavity of the case and attached to the plate, the thermal management device to allow for a fluid to flow through said porous medium to thermally couple the die to the heat exchanger.

As can be seen, claim 32 clearly recites a porous medium attached to a plate of a case that is, in turn, attached to the die. The inventors of the present invention have discovered that this unique and novel arrangement provides heat transfer efficiencies through development and maintenance of two-phase flow at relatively low flow rates through the porous medium. This is done by the medium providing nucleation points in

close proximity to the die so that the heat transferred from the die is of a sufficient quantity to boil the liquid at said relatively low flow rates. See, for example, paragraph [0023] of the present specification.

Furthermore, this unique and novel arrangement may also provide for heat transfer efficiencies by allowing for customization of heat-transfer attributes of various areas of the thermal management device to various heat distributions over the surface of the die. For example, this arrangement may provide heat-transfer customization by customizing porous medium characteristics, e.g., pore size, to correspond to a particular thermal energy output of an area of the die. See, e.g., paragraph [0016] and claims 34, 39, and 56. The interconnected nature of the pore channels of the porous medium may also allow for an equilibration of pressure from high to low pressure areas, which result from relatively hot and cool spots on the surface of the die. This may result in a cooling liquid (and thereby heat transfer capability) flowing to the areas associated with concentrated thermal energy. See, for example, paragraph [0024] and claim 51. These noted heat transfer efficiencies may potentially increase the overall heat transfer abilities of the apparatus recited in claim 32.

The teachings of the cited references, on the other hand, differ from claim 32, when viewed as a whole, for at least the reason that they each provide one or more structures between the porous medium/case plate and the die. For example, Ozmat teaches coupling of the sponge **19** to the chips **3**, **7**, and **9**, through solder balls (shown in FIG. 3, but not discussed), a substrate **11**, and a metal matrix composite (MMC) plate **13**. These interposing structures between the chips and the porous medium, by design or effect, diffuse and distribute the heat sourced by the chips thereby failing to provide an opportunity to realize the above-identified heat transfer efficiencies discussed in relation to claim 32, for example. Similarly, Weber teaches that the heat source is a circuit board (see paragraph [0022]) and Wirtz teaches that the heat source is a microprocessor package (see Abstract).

For at least these reasons, the apparatus claimed in claim 32, when viewed as a whole, is patentably distinct from the teachings of the cited references.

Claims 33 – 45 and 50 – 58 depend from, or include limitations similar to, claim 32. These claims also include limitations in addition to those discussed above that further distinguish them from cited references. While it is not necessary to provide an exhaustive list of these additional limitations at this time, some of them include:

- the porous medium being configured based at least in part on a non-uniform heat distribution over a surface of a die;
- an area of the porous medium having a plurality of pores elongated in a direction; and
- fluid flow being primarily induced by natural buoyancy resulting from the fluid absorbing thermal energy output from the die; and
- wherein the case hermetically encompasses the porous medium.

For at least these reasons, these claims are patentably distinct from the cited references.

Claim 46 recites an apparatus comprising, in part, a thermal management device having a porous medium attached to a die. The porous medium is disposed within a cavity of a case of the thermal management device. By having the porous medium attached directly to the die, this claim provides for heat transfer efficiencies similar to those discussed above with reference to claim 32. Because, as discussed above, the cited references do not teach, suggest, or imply such an apparatus, this claim is also patentable over said references.

Additionally, claims 47 – 49 depends from claim 46 and are patentable over cited references for at least the same reasons.

CONCLUSION

In view of the foregoing, Applicants respectfully submit that claims 32 - 58 are patentable. Thus, early issuance of Notice of Allowance is respectfully requested.

The Commissioner is hereby authorized to charge shortages or credit overpayments to Deposit Account No. 500393. .

Should there be any lingering questions, Applicant invites the Examiner to call the undersigned to have the questions resolved to allow the subject application to expeditiously pass to issuance.

Respectfully submitted,

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